Predicting a Fat's Behavior in Food Products

Improving shelf life and minimizing off-flavors in margarines, shortenings, and cooking oils is important to both food manufacturers and consumers. But accomplishing this isn't easy because fats are complex mixtures of molecules.

What food manufacturers need is a way to predict how fats—specifically those known as triglycerides—will act in food formulations and during storage. Currently, food manufacturers use trial and error during the early phases of product development, which is time-consuming and costly.

Now, ARS researchers in the Food Quality and Safety Research Unit at the National Center for Agricultural Utilization Research (NCAUR) in Peoria, Illinois, have developed an analytical technique to help food manufacturers shave months off product development.

The new technique is a scientific mouthful—reversed-phase high-performance liquid chromatography (HPLC)/atmospheric pressure chemical ionization (APCI) with mass spectrometry (MS). It sounds complicated, but HPLC/APCI-MS can actually simplify identification of triglycerides.

"It's faster, more accurate, and less time consuming than normal chemical analysis," says ARS chemist Gary R. List, who leads food quality and safety research at NCAUR. The technique can identify 35 to over 100 triglycerides in 2 hours and helps researchers correlate triglyceride composition with the physical properties it imparts to food: melting range, mouth feel, and reaction to refrigeration.

ARS chemist William E. Neff and Florida-Atlantic University researcher W. Craig Byrdwell (formerly with ARS) perfected HPLC/APCI-MS in the laboratory. Previously, researchers used a one-dimensional system of liquid chromatography, which allowed them to see a single peak indicating a triglyceride.

"But seed oils are a complex mixture of triglyercides, with compounds that overlap," says Byrdwell. "Mass spectrometry allows us to see signature masses for each individual triglyceride so that even if they overlap, they can still be identified without being confused. This method is also helpful in evaluating seed oils with modified fat compositions, like sunflower or soybean, because there is no standard reference for the chemical composition of these oils."

"Using APCI-mass spectrometry is an easier way to work the puzzle," says Neff. "It can be used to break fat molecules into a few large pieces so that we can clearly identify their composition. We can see triglycerides intact before they break down to form decomposition products during storage or high-temperature frying."

What happens to oils during frying? ARS food technologist Kathleen A. Warner in Peoria says, "they break down under high temperatures, which causes them to turn dark and have an unpleasant odor."

To help understand what these breakdown compounds are, Warner and Neff used simple oils such as triolein and trilinolein as model frying oils. The information from the simple oils will provide a comparison to other breakdown products in more complicated oils such as sunflower and corn oils.

Warner gets feedback about the oils' taste and smell from trained sensory panel members. She and Neff send frying oils to Byrdwell for APCI-MS analysis of the triglyceride decomposition products. The data are then compared with the observations of sensory panel members.

Oils may someday be designed not only to resist formation of the negative byproducts, but also to produce desirable flavors. The ultimate goal of this research: to provide consumer products that last longer on the shelf and withstand frying better to provide more healthful, better tasting foods.—By **Linda McGraw,** ARS.

This research is part of New Uses, Quality, and Marketability of Plant and Animal Products, an ARS National Program (#306) described on the World Wide Web at http://www.nps.ars.usda.gov/programs/cppvs.htm.

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Using a "sniffing" apparatus, chemist William Neff determines the odor intensity of each component of soybean oil while technician Wilma Rinsch operates the equipment used to perform the test.